Introduction to Network Security

Chapter 4

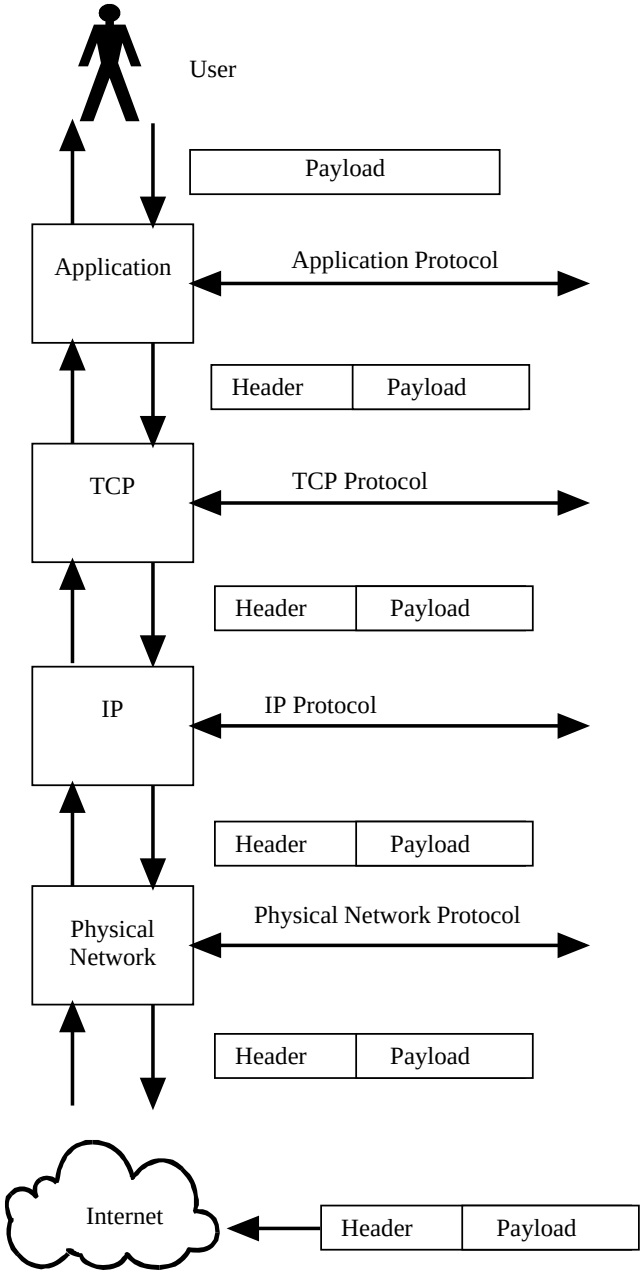
Taxonomy of Network-Based Vulnerabilities

Topics

- Network Security Model
- Header attacks
- Protocol Attacks
- Authentication Attacks
- Traffic attacks

Network Security

- Who (authentication)
  - Good guys
  - Bad Guys
- What to Attack
  - Protocols
  - Network connected Applications
  - Infrastructure

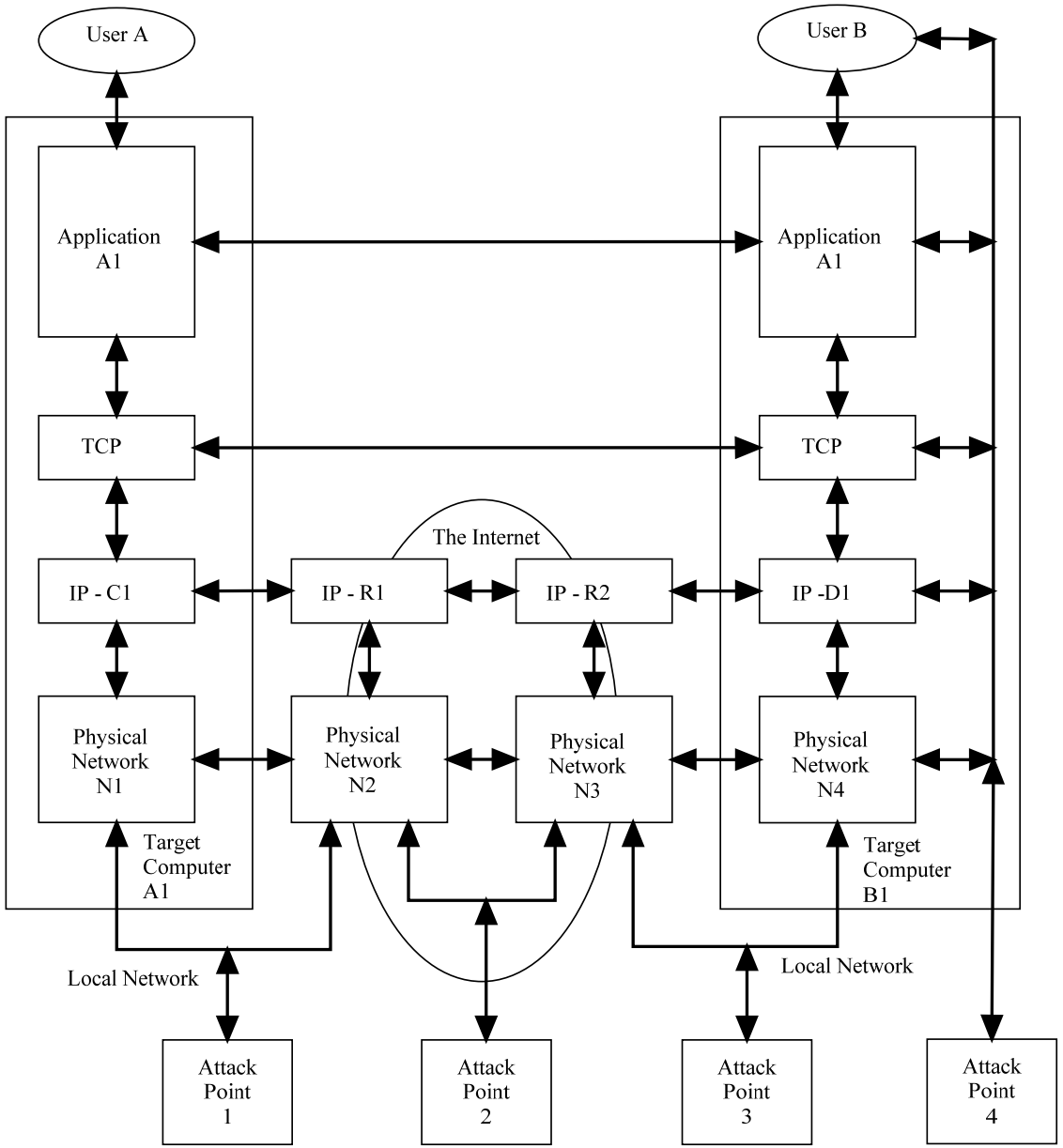


Attacker Generated Packet

Layered Model of Attack Data

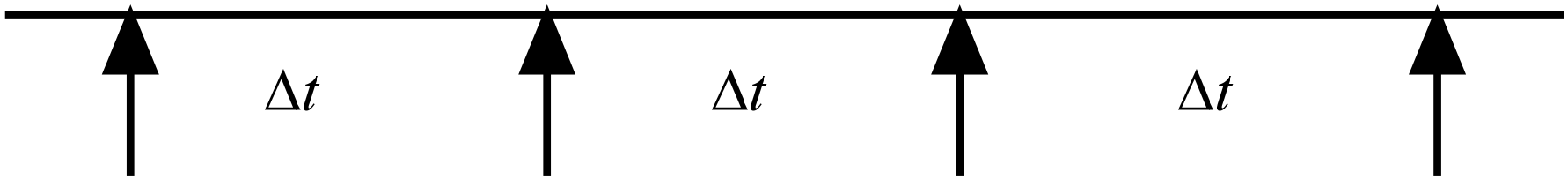
- Each layer receives data from the layer below and passes data to the layer above it without looking at it
- An attacker can insert information into the payload in order to send data to a particular layer

Threat Model



- Attacker 1 & 3 can attack any layer on computers connected to the same network
- Attacker 2 can attack the TCP & Application layers of computers A1 & B1 and the IP layer of any device
- Attacker 4 has taken over the computer

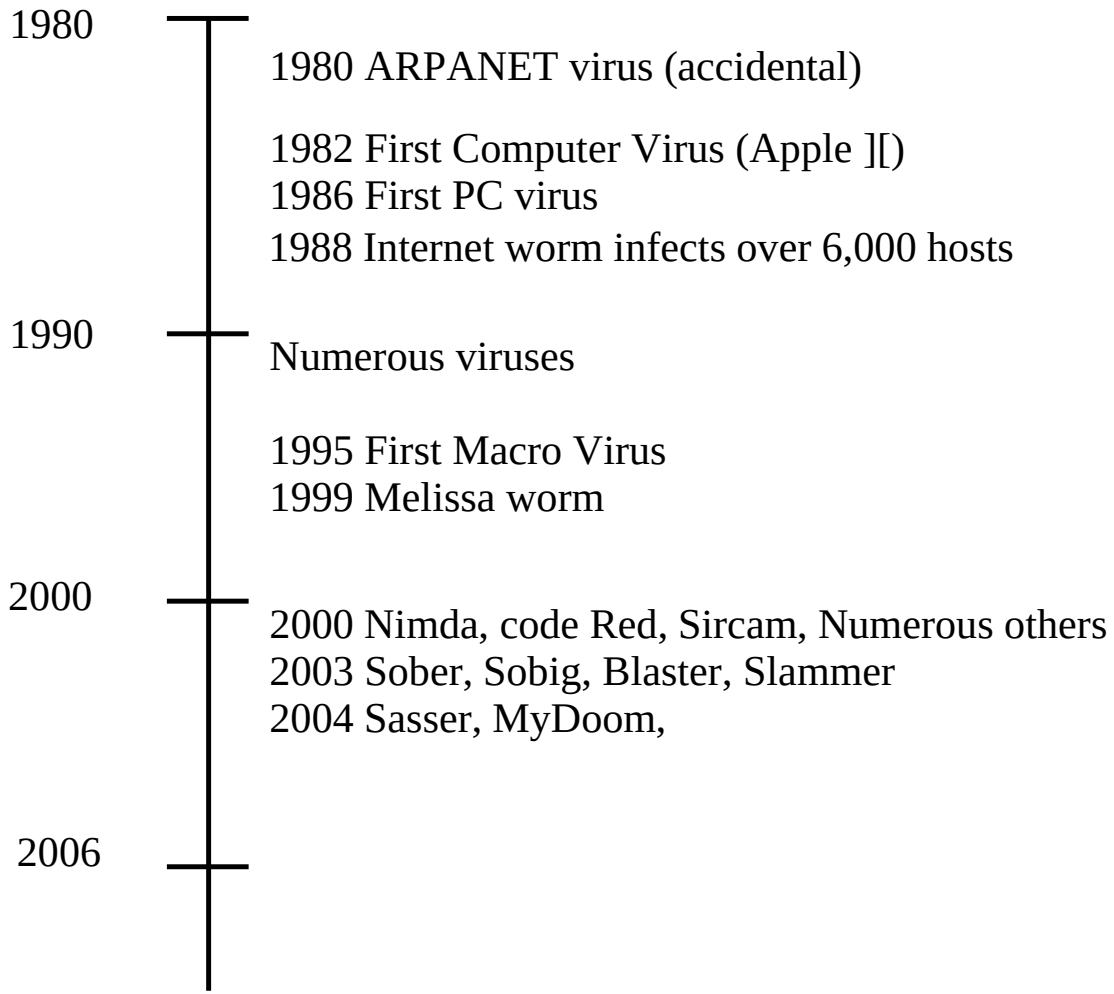
Vulnerabilities, Exploits and Attacks



Design Vulnerability
Implementation Vulnerability
Configuration Vulnerability

Attack Time Line

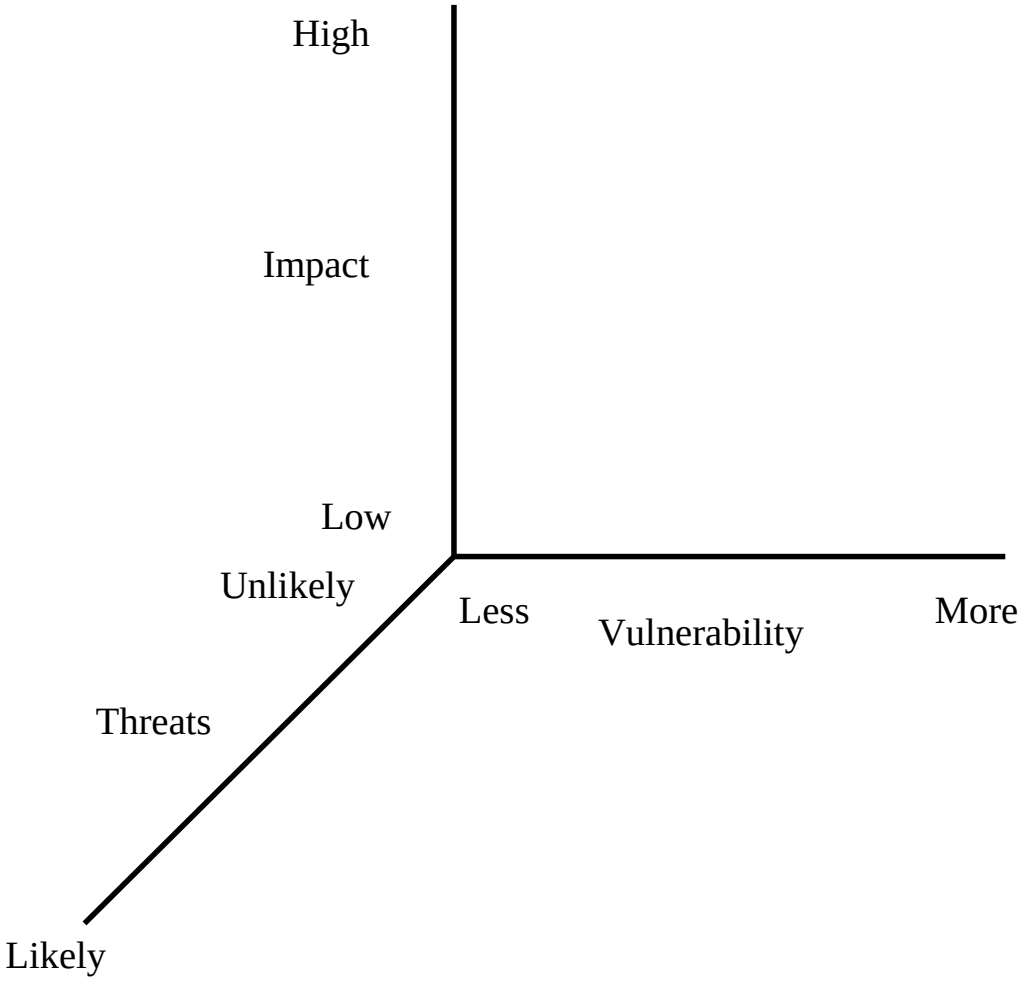
- Time between attacks has decreased and scale of attacks has increased
- Attacks now have multiple variations that can occur within hours of each other



Risk & Risk Assessment

- Risk is a measure of how critical something is and is a combination of:
  - **Threat** (How likely is it that the target will be attacked)
  - **Vulnerability** (How likely there is a weakness in the target)
  - **Impact** (What is the effect of losing the target)
- Risk assessment is the process where you decide how important something is and how hard you are going to work to protect it.

Risk Graph


High
Impact
Low
Unlikely
Less
Vulnerability
More
Threats
Likely

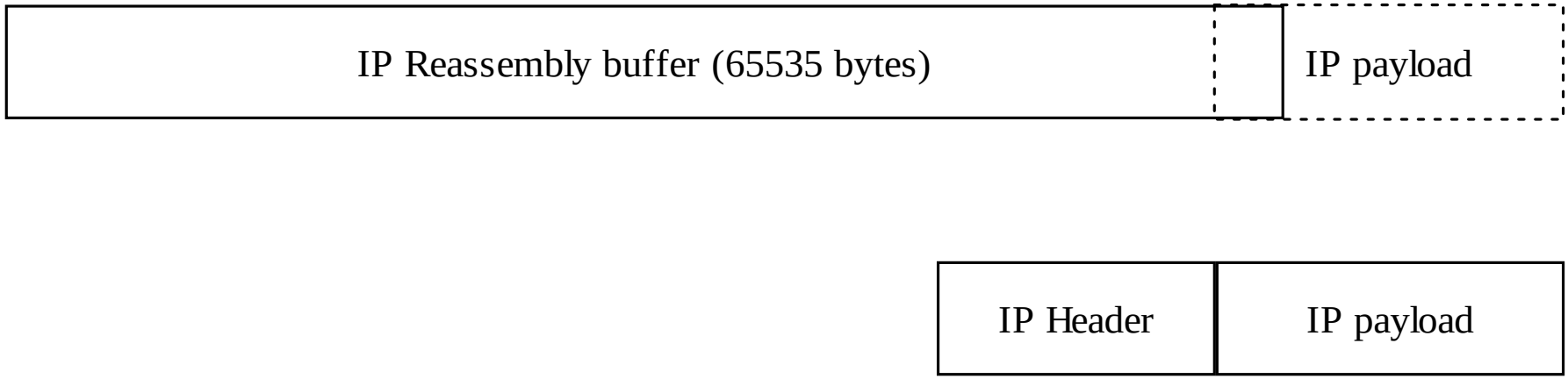
Network Security Taxonomy

- Header based
- Protocol based
- Authentication based
- Traffic Based

Header Based

- Creation of invalid packets, different protocols handle bad packets differently
- Source and destination address manipulation
  - Device can be confused by setting source and destination to the same address
- Setting bits in the header that should not be set
- Putting values in the header that are above or below the level specified in the standard

Example: Ping of Death



offset = 65528 (max value)
length = 100

Network Protocol Issues

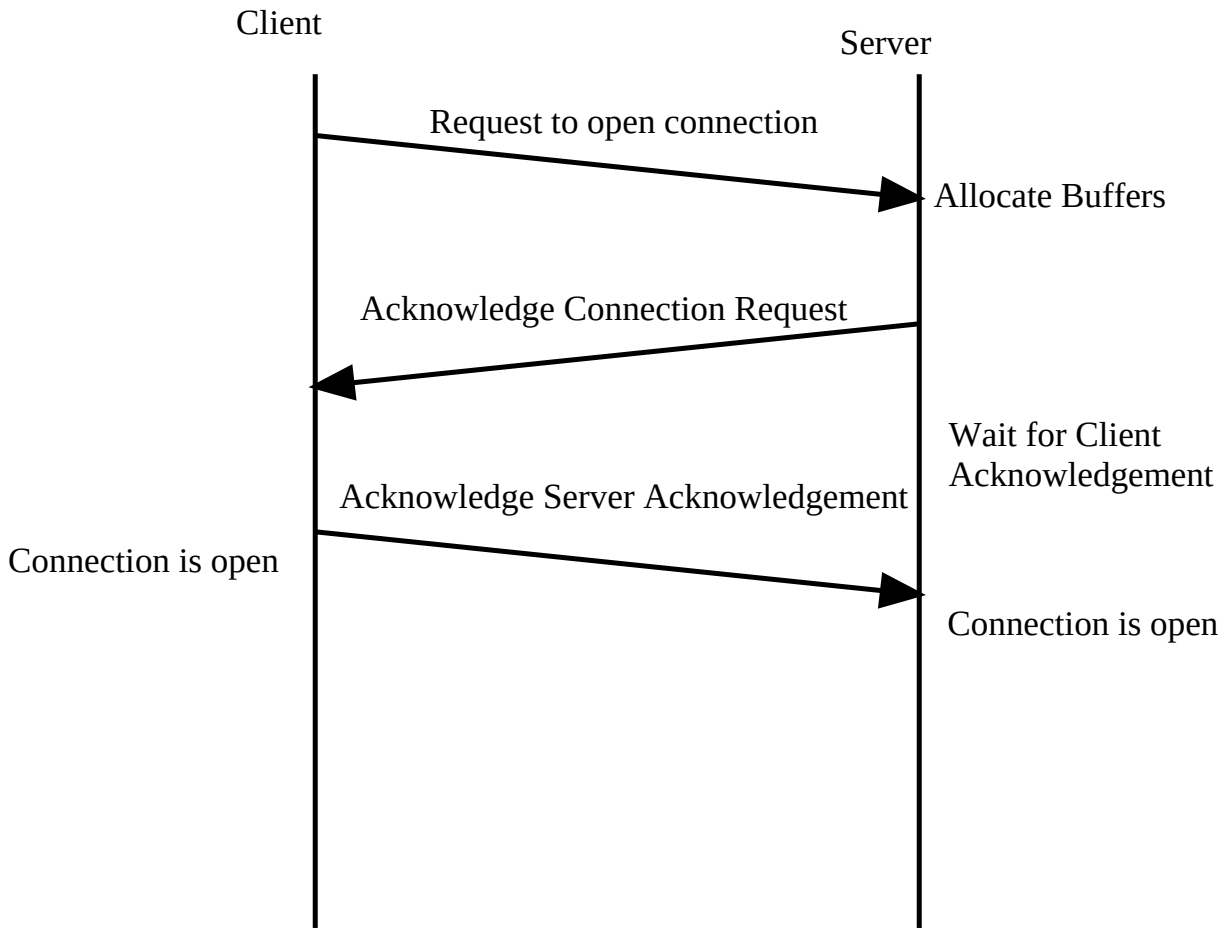
- Timing / procedural
  - Who talks first, who says what and when
  - Think of a phone call conversations, there is a protocol, the person picking up the phone talks first
  - Attacks usually involve valid packets that are out of order, arrive too fast, or are missing packets

Protocols attacks

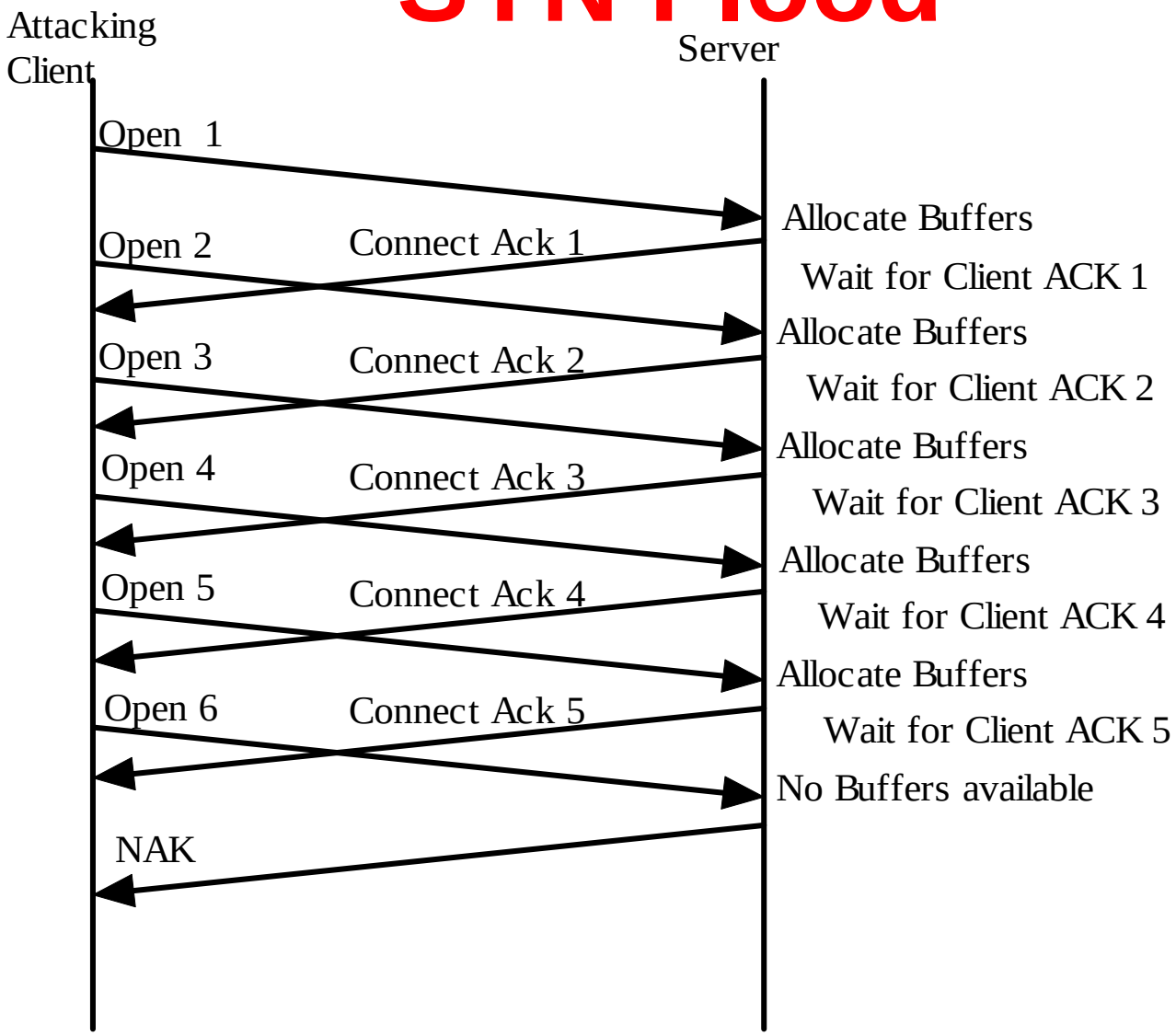
- You can shutdown the protocol itself
- Send packets telling the device to stop talking
- For connectionless protocols you can answer as the server and tell the client the server is down.

Example: Syn Flood

- TCP 3-way Handshake

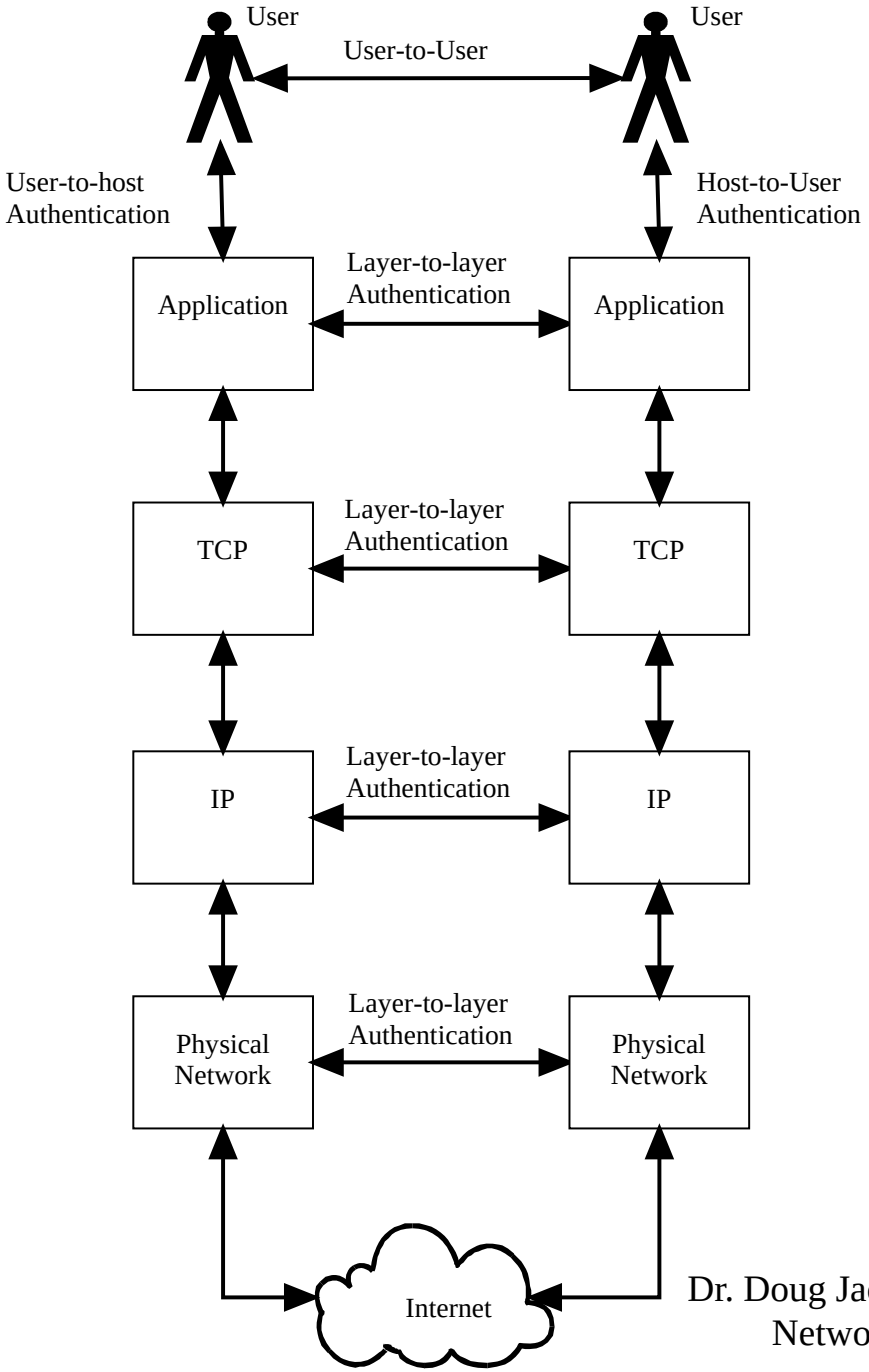


SYN Flood


Attacking Client
Server
Open 1
Allocate Buffers
Open 2
Connect Ack 1
Wait for Client ACK 1
Allocate Buffers
Open 3
Connect Ack 2
Wait for Client ACK 2
Allocate Buffers
Open 4
Connect Ack 3
Wait for Client ACK 3
Allocate Buffers
Open 5
Connect Ack 4
Wait for Client ACK 4
Allocate Buffers
Open 6
Connect Ack 5
Wait for Client ACK 5
No Buffers available
NAK

Authentication-Based

- Authentication is the proof of one's identity to another.
- Often thought of as username & password based
- In a network addresses are often used to authenticate packets.
  - Like the 4 addresses used to identify a packet in the Internet



Network Authentication

Authentication

- Four different types of authentication
  - User to host
    - Person proves the identity to computer resource
    - Most prevalent
  - Host to Host
    - Work being done to strengthen this
    - In past usually done by IP address
  - User to User
    - Contracts, secure email
    - Useful for online auctions
  - Host to User
    - Server authenticating to user

Traffic-Based

- Too much data
  - To a single:
    - Application
    - Network device
    - Protocol layer
  - From:
    - Multiple machines
    - Single attackers
- Traffic Capture (sniffing)

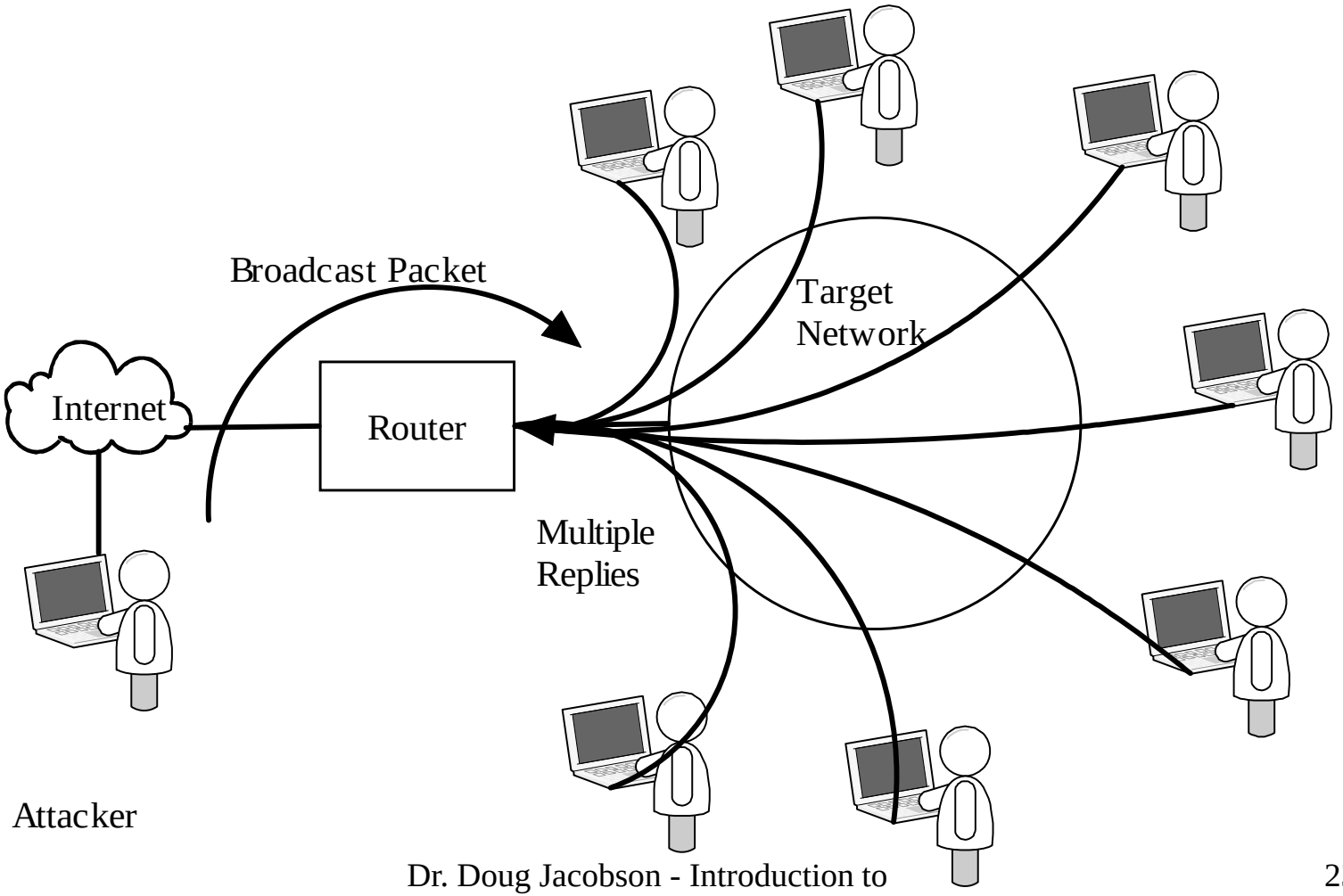
Traffic Attacks

- You can shutdown a service by:
  - flooding it with packets
  - opening a large number of connections
- You can shutdown network by:
  - flooding it with a large number of packets.
  - Broadcast packets will do the most damage
- You can shutdown a machine by:
  - flooding a machine with packets on multiple services
  - Broadcast storms

Denial of Service

- Denial of service is when a third party prevents valid network users access to services, machines, or applications
- Denial of service attacks can be difficult to detect and even harder to defend against.

Broadcast Flood Attack



Traffic Capture

- Packet sniffing can be played out against any layer in the network if the attacker is in a position to “see” the traffic.

Applying the Taxonomy

- Goal versus method
- The taxonomy applies to the method
  - Breaking authentication maybe the goal, but the method maybe be header-based
- Not all attacks will be covered since not all attacks are network based.